PROJECT facts

U.S. DEPARTMENT OF ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

ENVIRONMENTAL WATER AND RESOURCES

06/2000

INJECTION OF COAL COMBUSTION BYPRODUCTS (CCB'S) INTO THE OMEGA MINE FOR THE REDUCTION OF ACID MINE DRAINAGE

PRIMARY PROJECT PARTNER

West Virginia Division of Environmental Protection
Nitro, WV

MAIN SITE

Omega Mine
Monongalia County, WV

TOTAL ESTIMATED COST

$2,179,885

COST SHARING

DOE	$ 200,000
Non-DOE	$1,979,885

Description

The problem of acid mine drainage (AMD) from abandoned underground coal mines in the Eastern U.S. is well-documented. At the same time, coal combustion technologies which use lime or limestone as a means of controlling sulfur emissions can produce by-products which contain large amounts of excess alkalinity. Therefore, there has been considerable interest in using alkaline coal combustion byproducts (CCB's) to reduce the overall cost of remediating AMD from abandoned underground mines. Even when CCB's do not possess sufficient alkalinity to allow them to be used in strictly an acid neutralization capacity, they can often be engineered to produce grout-like materials whose permeabilities are very low. By injecting large volumes of CCB grouts into abandoned underground mines such that most or all of the void spaces are filled, it may be possible to divert ground water away from acid-forming materials in the mine. The Omega Mine project represents a full-scale demonstration of this concept.

The Omega underground mine, located in Monongalia County, WV, approximately 8 km south of the city of Morgantown, was operated during the early to mid-1980's but has since been abandoned. Depending on the season of the year and the amount of precipitation in the mine area, four to ten discrete acidic mine discharges emanate from the down-dip outcrop of the mined coal seam. Two of the discharges came from horizontal boreholes which were drilled through the coal outcrop into the mine workings to prevent the uncontrolled buildup of water pressure within the mine (which could subsequently cause a catastrophic blowout of mine water). The other discharges flow from small "punch mines" into the down-dip outcrop; these mines are believed to be hydrologically connected to the larger Omega mine. All discharges are routed to a chemical treatment system consisting of anhydrous ammonia for pH elevation, liquid hydrogen peroxide to promote iron oxidation, and a series of settling ponds for metal hydroxide sludge precipitation and storage. The treatment system is operated by the West Virginia Division of Environmental Protection (WVDEP) at a cost of approximately $300,000 per year.

The objective of this project was to reduce the severity of the AMD from the Omega mine by completely filling a 23-acre portion of the mine with a grout composed primarily of CCB's. Baseline hydrologic and water quality data from the mine, which had been collected since 1993, showed that the discharges from the targeted area (North Lobe) of the mine comprised 70 to 90 percent of the total AMD load from the mine complex. It was anticipated that filling the North Lobe with CCB grout would divert ground water away from important acid-

Injection of Coal Combustion Byproducts (CCB's) Into the Omega Mine for the Reduction of Acid Mine Drainage

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PROJECT PARTNERS

Anker Energy, Inc.
Morgantown, WV
(FBC ash supplier, cofunding)

CONSOL, Inc.
Pittsburgh, PA
(cofunding)

Electric Power Research Institute
Palo Alto, CA
(cofunding)

Allegheny Power
Fairmont, WV
(fly ash supplier, cofunding)

U. S. Office of Surface Mining
Washington, DC
(cofunding)

GAI Consultants, Inc.
Charleston, WV
(engineering design)

Howard Concrete Pumping, Inc.
(grouting contractor)

producing zones, thereby significantly reducing the total AMD load and lowering the long-term AMD treatment costs incurred by the State of West Virginia.

Grouting operations began in May 1998 and were completed in November 1998. The grout mix consisted of 49% pulverized coal fly ash from Allegheny Energy's Fort Martin Power Station, 49% fluidized bed combustion (FBC) ash from Anker Energy/Morgantown Energy Associates FBC plant, 2% Portland cement, and water at about 100 gal per cubic yard of grout. Water for grout mixing was obtained by upgrading the local township water supply line and tapping into the line. Approximately 80,000 cubic yards of grout were needed to fill the target area through 227 injection bore-holes. Lateral flow around each vertical injection borehole was approximately 50 ft in areas where roof collapse had occurred, and up to 500 ft in open entries where roof collapse had not occurred. Compressive strength of the solidified grout (28-day value) was 200 to 600 psi. In the areas of the mine closest to the coal outcrop, where it was critical to create as tight a seal as possible, grout penetration into collapsed areas was maximized by using pressure grouting with a more fluid mix consisting of only fly ash and cement.

By the end of the grouting period, flow from the North lobe discharges had decreased to levels that were as low as any that had been measured previously. However, the mine area had experienced extremely dry conditions throughout the final three months of injection, so it was uncertain whether the decreased flow rates resulted solely from grouting. Monthly sampling and analysis of all discharges emanating from the Omega mine will be performed for at least three additional years to determine the long-term effectiveness of the CCB grouting procedure in reducing the AMD load.

Goal

To ensure the most cost-efficient delivery of electrical power, the U.S. Department of Energy (DOE) is conducting research and development to improve coal combustion byproduct (CCB) management. The research program emphasizes characterization and reuse of CCBs to help stimulate markets for new materials such as those produced under the DOE's Clean Coal Technology program. Over the next 5 to 10 years, the program's goals are to develop processes leading to a 100% increase in the current rate of FGD byproduct use, a 10% increase in the national rate of overall CCB use, and a 25% increase in the number of CCB applications considered "allowable" under state regulations.

Benefits

- The Omega Mine project provides a large-scale demonstration of the feasibility of using CCB grout to divert ground water away from acid-producing zones within an abandoned underground coal mine.
- Costs of the CCB grouting procedure (and remaining chemical treatment, if necessary) can be compared to the costs of conventional chemical treatment to determine whether selective CCB grouting can be used cost-effectively at other, similar sites.